U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

3.5.2 STRUCTURES, SYSTEMS, AND COMPONENTS TO BE PROTECTED FROM EXTERNALLY GENERATED MISSILES

REVIEW RESPONSIBILITIES

Primary - ~~Auxiliary~~Plant Systems Branch ~~(ASB)~~(SPLB)[1]

Secondary - None

I. AREAS OF REVIEW

The ~~ASB~~SPLB[2] review of the structures, systems, and components (SSC) to be protected from externally generated missiles includes all safety-related SSC on the plant site that have been provided to support the reactor facility. These include such elements as essential service water intakes, buried components (e.g., essential service water piping, storage tanks), and access openings and penetrations in structures.

The ~~ASB~~SPLB[3] reviews the functional operations or performance requirements for SSC to assure conformance with the requirements of General Design Criteria 2 and 4 and identifies the SSC that are necessary for the safe shutdown of the reactor facility and the SSC whose failure could result in a significant release of radioactivity. Safety-related SSC are reviewed with respect to their capability to perform functions required for attaining and maintaining a safe shutdown condition during normal or accident conditions, mitigating the consequences of an accident, or preventing the occurrence of an accident assuming impact from externally generated missiles. If the turbine is not properly oriented, ~~AEB will request ASB to~~SPLB will[4] also review the protection of SSC from the effects of turbine missiles.
Based on their relation to safety, structures or areas of structures, systems or portions of systems, and components are identified as requiring protection from externally generated missiles if a missile could prevent the intended safety function, or if as a result of missile impact on a

nonsafety-related SSC, its failure could degrade the intended safety function of a safety-related SSC.

Review Interfaces:[5]

The SPLB also performs the following review under the SRP sections indicated:[6]

Specific missile sources and the protection needed are reviewed under SRP Sections 3.5.1.1, 3.5.1.2, 3.5.1.4, 3.5.1.5, and 3.5.1.6.[7]

The SPLB will coordinate other branches' evaluations that interface with the overall review as follows:[8]

The ~~SEB~~Civil Engineering and Geosciences Branch (ECGB)[9] will determine the acceptability of barriers and structures designed to withstand externally generated missiles as part of its primary responsibility for SRP Section 3.5.3.

For those areas of review identified above as being part of the review under other SRP sections, the acceptance criteria and their methods of application are contained in the referenced SRP sections.[10]

II. ACCEPTANCE CRITERIA

Acceptability of the list of SSC to be protected against externally generated missiles, presented in the applicant's safety analysis report (SAR), is based on specific general design criteria and regulatory guides.

The identification of ~~structures, systems, and components~~SSC[11] to be protected against externally generated missiles is acceptable if it is in accordance with General Design Criterion 2, with respect to ~~protection~~design[12] of SSC important to safety ~~from~~to withstand[13] the effects of natural phenomena and General Design Criterion 4, with respect to appropriate[14] protection of SSC important to safety against the effects of externally generated missiles to maintain their essential safety functions. Acceptance is based on the design meeting the guidelines of Regulatory Guide 1.13, as related to the spent fuel pool systems and structures being capable of withstanding the effects of externally generated missiles and preventing missiles from contacting stored fuel assemblies; Regulatory Guide 1.27, as related to the ultimate heat sink and connecting conduits being capable of withstanding the effects of externally generated missiles; Regulatory Guide 1.115, as related to the protection of SSC important to safety from the effects of turbine missiles; and Regulatory Guide 1.117, as related to the protection of SSC important to safety from the effects of tornado missiles.[15]

Technical Rationale:[16]

The technical rationale for application of the above acceptance criteria to SSC to be protected from externally generated missiles is discussed in the following paragraphs.

1. GDC 2 establishes requirements regarding the ability of SSC important to safety to withstand natural phenomena without the loss of capability to perform their safety functions. This criterion applies directly to the assessment of SSC in regard to external missiles generated by natural phenomena. Application of GDC 2 ensures that the chosen design basis reflects the importance of the safety functions to be performed. Regulatory Guide 1.13 describes a method acceptable to the NRC staff for protecting spent fuel pool systems and structures from externally generated missiles and preventing mechanical damage to the spent fuel. Mechanical damage to the spent fuel is prevented by designing the facility to prevent externally generated missiles from contacting the spent fuel within the pool. Identifying the systems and structures that prevent mechanical damage to the spent fuel allows for proper designation of the SSC to be protected from externally generated missiles. Regulatory Guide 1.27 describes a method acceptable to the NRC staff for protecting the ultimate heat sink and connecting conduits from the effects of externally generated missiles. The ultimate heat sink constitutes the source of water supply necessary to safely operate, shutdown and cool down a nuclear plant. Because the ultimate heat sink is important to safety, its SSC important to safety should be identified and their safety functions should be ensured. Protecting the ultimate heat sink SSC that are important to safety from externally generated missiles ensures that the system can perform its safety function of providing a heat sink. Identifying and protecting SSC important to safety from externally generated missiles ensures the safety function of those SSC, such as; ensuring the integrity of the spent fuel pool and thereby mitigating the potential release of fission products, and ensuring the capability of the ultimate heat sink to provide a heat sink and maintain the plant in a safe condition.

2. GDC 4 establishes requirements regarding the ability of SSC important to safety to be protected from dynamic effects, including the effects of missiles from events and conditions outside the nuclear unit. Dynamic events originating outside the nuclear unit have the potential for generating missiles, therefore, this criterion applies directly to the assessment of SSC important to safety that may be effected. Regulatory Guide 1.115 describes methods acceptable to the NRC staff for identification and protection of SSC important to safety from the effects of missiles resulting from turbine failure. Cumulative failure data for conventional plants indicate that the protection of SSC important to safety from the effects of missiles is an appropriate safety consideration. Regulatory Guide 1.117 describes a method acceptable to the NRC staff for determining which SSC should be protected from external missiles generated by tornados. The selection of SSC to be protected is based upon not allowing offsite exposures to exceed an appropriate fraction of the offsite dose guidelines of 10 CFR Part 100. Basing the limits upon an appropriate fraction ensures protection for those events that are not as severe as the design-basis event but have a higher probability of occurrence. Identifying SSC important to safety so that they may be protected from externally generated missiles ensures: the integrity of the reactor coolant pressure boundary, the capability to shutdown the reactor and maintain it in a shutdown condition and the capability to prevent significant uncontrolled release of radioactivity.

III. REVIEW PROCEDURES

The procedures set forth below are used during the construction permit (CP) review to determine that the applicant's list of SSC that require protection from externally generated missiles is complete and meets the acceptance criteria given in subsection II of this SRP section. For operating license (OL) applications, the procedures are used to verify that the CP-stage list continues to be applicable and complete, or has been supplemented as appropriate. The reviewer will select and emphasize material from the paragraphs below, as may be appropriate for a particular case.

The first step in the review is to verify the identification of the safety- related SSC, and whether the SSC are considered safety related in their entirety or have only portions that are safety related. In order to determine the safety category of the SSC, the ~~ASB~~SPLB[17] evaluates the SSC of the facility with respect to their necessity for achieving and maintaining safe reactor shutdown, and for performing accident prevention or mitigation functions. The information provided in the SAR pertaining to SSC design bases, design criteria, descriptions and safety evaluations, together with the system and component characteristic tables and safety classification tables are reviewed to identify safety functions performed by the SSC. In general, the safety functions to be performed by the SSC in various designs remain essentially the same. However, the location or arrangement of the SSC and the methods used vary from plant to plant depending upon the individual designer. The reviewer identifies variations in design and evaluates them on a case-by-case basis.

The second step in the review is to determine the SSC, or portions of SSC, that require protection against externally generated missiles. The reviewer uses engineering judgment and the results of failure modes and effects analyses in conjunction with the results of reviews under other SRP sections for specific SSC in determining the need for missile protection. Most safety-related systems are located within structures that are resistant to external missiles by virtue of design for other purposes (e.g., primary containment), or because the structures are constructed specifically to withstand missiles. Systems and components located within such structures are considered adequately protected. The reviewer concentrates his attention on safety- related SSC located outside such structures and on penetrations and access openings in the structures. Essential service water piping and components, storage tanks, and ultimate heat sink components are examples of SSC typically located outside missile-resistant structures. Site specific systems such as the ultimate heat sink may be excepted from the scope of design certification. The detailed review of the site specific systems to be protected from missiles for a standardized design is therefore typically deferred until review of applications referencing the certified design.[18] Depending on the nature and source of the externally generated missiles, protection may be provided by missile barriers for individual components, by locating independent redundant systems in compartments located in a missile protected structure, or by subgrade location at a sufficient depth. Physical separation alone is not normally an acceptable method of missile protection for redundant safety-related systems and components located in nonmissile protected independent structures. ~~Specific missile sources and the protection needed are considered in other SRP sections in the 3.5.1 series.~~[19]

The reviewer determines that nonsafety-related SSC are identified as requiring protection from externally generated missiles if as a result of their failure by a missile, the consequences could

prevent the intended safety function of a safety-related SSC. In addition, any failure of nonsafety-related SSC that could result in external missile generation should not prevent safety-related SSC from performing their intended safety function. The reviewer also verifies for those applicants referencing a certified design that SSC outside of the design certification scope that may result in external missile generation would not prevent safety-related SSC from performing their intended safety function.[20]

For standard design certification reviews under 10 CFR Part 52, the procedures above should be followed, as modified by the procedures in SRP Section 14.3 (proposed), to verify that the design set forth in the standard safety analysis report, including inspections, tests, analysis, and acceptance criteria (ITAAC), site interface requirements and combined license action items, meet the acceptance criteria given in subsection II. SRP Section 14.3 (proposed) contains procedures for the review of certified design material (CDM) for the standard design, including the site parameters, interface criteria, and ITAAC.[21]

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided and his review supports conclusions of the following type, to be included in the staff's safety evaluation report:

> The review of the structures, systems and components (SSC)[22] to be protected from externally generated missiles included all safety-related ~~structures, systems, and components~~SSC[23] provided to support the reactor facility. Based on the review of the applicant's proposed design criteria, design bases, and safety classifications for SSC necessary for safe reactor shutdown, the staff concludes that the SSC to be protected from externally generated missiles are in conformance with General Design Criteria 2 and 4. This conclusion is based on the following:
>
> The applicant has met the requirements of General Design Criteria 2 and 4 with respect to protection of SSC important to safety against the effects of externally generated missiles by:
>
> (1) Meeting Regulatory Position C.2 of Regulatory Guide 1.13, "Spent Fuel Storage Facility Design Basis," by preventing missiles generated by tornado winds from causing significant loss of watertight integrity of the fuel storage pool, and from contacting fuel within the pool;
>
> (2) Meeting Regulatory Position C.2 and C.3 of Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants," so that the ultimate heat sink is capable of withstanding the effects of external missiles generated by natural phenomena;
>
> (3) Meeting Regulatory Position C.1 in Regulatory Guide 1.115, "Protection Against Low Trajectory Turbine Missiles," such that essential systems are protected from low-trajectory turbine missiles either by proper turbine orientation or by missile barriers;

(4) Meeting Regulatory Positions C.1, 2, and 3 and the appendix to Regulatory Guide 1.117, "Tornado Design Classification," such that SSC important to safety are protected from the effects of missiles generated by the Design Basis Tornado by providing missile barriers for individual components, locating independent redundant systems or components in missile protected structures or by underground locations at a depth sufficient to protect against missiles; and

(5) Identifying all SSC requiring protection against the effects of externally generated missiles~~:~~, including those nonsafety-related SSC whose failure as a result of missiles may prevent safety-related SSC from performing their safety-related functions.[24]

For those applicants referencing a certified design, the reviewer finds that SSC outside of the design certification scope that may result in external missile generation will not prevent safety-related SSC from performing their intended safety function.[25]

For design certification reviews, the findings will also summarize, to the extent that the review is not discussed in other safety evaluation report sections, the staff's evaluation of inspections, tests, analyses, and acceptance criteria (ITAAC), including design acceptance criteria (DAC), site interface requirements, and combined license action items that are relevant to this SRP section.[26]

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this SRP section.

This SRP section will be used by the staff when performing safety evaluations of license applications submitted by applicants pursuant to 10 CFR 50 or 10 CFR 52.[27] Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications docketed six months or more after the date of issuance of this SRP section.[28]

The implementation schedules for conformance to parts of the method discussed herein are contained in the referenced regulatory guides.

VI. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."

2. 10 CFR Part 50, Appendix A, General Design Criterion 4, "Environmental and ~~Missile~~Dynamic Effects[29] Design Bases."

3. 10 CFR Part 100, §100.11, "Determination of Exclusion Area, Low Population Zone, and Population Center Distance."[30]

~~3~~4[31]. Regulatory Guide 1.13, "Spent[32] Fuel Storage Facility Design Basis."

~~4~~5. Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants[33]."

~~5~~6. Regulatory Guide 1.115, "Protection Against Low-Trajectory Turbine Missiles."

~~6~~7. Regulatory Guide 1.117, "Tornado Design Classification."

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SRP Draft Section 3.5.2
Attachment A - Proposed Changes in Order of Occurrence

Item numbers in the following table correspond to superscript numbers in the redline/strikeout copy of the draft SRP section.

Item	Source	Description
1.	Current PRB names and abbreviations.	Editorial change made to reflect current PRB names and responsibilities for this SRP section.
2.	Current PRB names and abbreviations.	Editorial change made to reflect current PRB names and responsibilities for this SRP section.
3.	Current PRB names and abbreviations.	Editorial change made to reflect current PRB names and responsibilities for this SRP section.
4.	Current PRB names and abbreviations.	Editorial change made to reflect current PRB names and responsibilities for SRP sections. SPLB is now responsible for the review in regard to the effects of turbine missiles so the discussion on AEB requesting a review was changed.
5.	SRP-UDP format item.	Revised the review interface section of Areas of Review to be consistent with SRP-UDP required format that uses a number/paragraph format to distinguish individual reviews and supporting reviews performed by other PRBs.
6.	Editorial, SRP-UDP format item.	Due to the nature of the review interfaces currently documented in this SRP section the review interfaces subsection had to be divided into two main groups. A new introductory sentence consistent with the SRP-UDP format was added to introduce the reviews performed by SPLB.
7.	Editorial, SRP-UDP format item.	This review interface was moved forward from the review procedures to consolidate the review interfaces in accordance with the SRP-UDP formatting requirements.
8.	Editorial, SRP-UDP format item.	Due to the nature of the review interfaces currently documented in this SRP section the review interfaces subsection had to be divided into two main groups. A new introductory sentence consistent with the SRP-UDP format was added to introduce the reviews that are coordinated by SPLB.
9.	Current PRB names and abbreviations.	Editorial change made to reflect current PRB names and responsibilities for SRP section 3.5.3.
10.	Editorial, SRP-UDP format item.	Added a closing sentence for the review interface subsection that is consistent with the SRP-UDP format.
11.	Editorial.	Substituted the acronym SSC for the phrase "structures, systems, and components."
12.	Editorial	Revised to reflect the actual wording of the cited GDC.
13.	Editorial	Revised to reflect the actual wording of the cited GDC.

Item	Source	Description
14.	Editorial	Added a key word from the regulation. It should be noted that this SRP section does not verify that all SSC important to safety are identified as requiring protection from dynamic effects such as externally generated missiles.
15.	Disposition of PRB Comment, No change	The PRB requested that acceptance criteria addressed in ANSI/ANS 58.1-1982 be added. The SRP-UDP identified no Type I basis to support adding this criteria, however (i.e., no regulatory document directing such use of the standard which had the opportunity for public comment). Further, in Chapter 1, Section 4.5.5 of the EPRI Evolutionary Plant FSER, the staff stated that it has not endorsed this standard in response to its proposed use by EPRI related to internal missile design guidance. Thus, the requested change could not be implemented within the scope of the SRP-UDP.
16.	SRP-UDP format item, adding technical rationale.	Technical Rationale were developed and added for the Acceptance Criteria covering GDC 2, GDC 4, including discussions on Regulatory Guides 1.13, 1.27, 1.115 and 1.117. The SRP-UDP requires that technical rationale be developed for each of the Acceptance Criteria.
17.	Current PRB names and abbreviations.	Editorial change made to reflect current PRB names and responsibilities for this SRP section.
18.	10 CFR 52 applicability issue.	Added information clarifying the reviews for design certification and applications referencing a certified design in regard to site specific systems. The information added reflects the staff's review process to address site specific systems which are the responsibility of the COL applicant as described in Section 3.5.2 of the ABWR FSER (NUREG-1503).
19.	Editorial, SRP-UDP format item.	This sentence is a review interface, therefore, it was moved to the review interface subsection and deleted from the review procedures. The consolidation of review interfaces is consistent with the SRP-UDP required format.

Item	Source	Description
20.	10 CFR 52 applicability issue and **Integrated Impact #281.**	Added review procedures to clarify the position regarding the failure of non-safety-related SSC that can result in external missile generation and the resulting impact on safety-related SSC. The clarification included a discussion on the failure of non-safety-related SSCs due to tornado effects. Also a review procedure specific to those applicants referencing a certified design was added to address SSCs outside of the design certification scope which may result in external missile generation and the resultant impact on the safety-related SSCs. The distinctions and clarifications are consistent with the reviews documented in section 3.5.2 of the ABWR FSER (NUREG-1503).
21.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard paragraph to address application of Review Procedures in design certification reviews.
22.	Editorial.	This is the first use of the phrase "structures, systems and components" in the evaluation findings that can be included into an applicants review findings. Therefore, since this may be the first usage in such findings the acronym SSC is defined.
23.	Editorial.	Substituted the acronym SSC for the phrase "structures, systems, and components."
24.	Editorial and **Integrated Impact # 281**	Clarified evaluation finding IV.(5) in regard to the failure of nonsafety-related SSC and the resultant finding that the functions of safety-related SSC are not prevented as a result of such failures. This clarification is consistent with the review procedures and with the reviews documented in the ABWR FSER.
25.	**Integrated Impact #281.**	A evaluation finding was added for those applicants referencing a certified design to address the evaluation findings regarding the generation of missiles from the failure of SSC outside of the design certification scope and ensuring that safety-related SSC are not prevented from performing their safety-related functions. This evaluation finding is consistent with the conclusions documented in the ABWR FSER.
26.	10 CFR 52 applicability issue.	A new evaluation finding paragraph was added to address design certification and combined license reviews. The design certification evaluation finding statement is consistent with the general statement utilized in the SRP-UDP format. In addition an evaluation finding statement for combined license applications was added that is consistent with the evaluation findings as stated in the ABWR FSER section 3.5.2.

Item	Source	Description
27.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard sentence to address application of the SRP section to reviews of applications filed under 10 CFR Part 52, as well as Part 50.
28.	SRP-UDP Guidance	Added standard paragraph to indicate applicability of this section to reviews of future applications.
29.	Editorial and disposition of PI-21725.	The title of General Design Criteria 4 was revised from "Environmental and Missile Design Bases" to "Environmental and Dynamic Effects" reference PI-21725.
30.	SRP-UDP format item	Added reference listing for 10 CFR 100.11 as the location for the "10 CFR Part 100 exposure guidelines" cited in subsection II, Technical Rationale item 2.
31.	Editorial	Renumbered remaining references to reflect previous addition of a reference.
32.	Reference Verification.	The Regulatory Guide designation and title were corrected; the correct designation is 1.13 and its title is "Spent Fuel Storage Facility Design Basis" not "Fuel Storage Facility Design Basis."
33.	Reference Verification.	The title of Regulatory Guide 1.27 was corrected, its title is "Ultimate Heat Sink for Nuclear Power Plants" not "Ultimate Heat Sink."

Integrated Impact No.	Issue	SRP Subsections Affected
281	Failure of nonsafety-related SSC that could result in external missile generation should not prevent safety-related SSC from performing their intended safety function. Those applicants referencing a certified design are responsible for the design of SSCs outside of the design certification scope. Any failure of SSCs outside of the design certification scope that may result in external missile generation should not prevent safety-related SSCs from performing their intended safety function.	Subsection III: Added review procedures to the last paragraph discussing the failure of nonsafety-related SSC that could result in external missiles. Subsection IV: Clarified existing evaluation finding number (5) to fully address the missile related findings with regard to nonsafety-related SSC. Added an evaluation finding for those applicants referencing a certified design to address those nonsafety-related SSC that are outside of the design certification scope.